

CORDILLO DOWNS ROAD
BIRDS, MAMMALS & VEGETATION SURVEY 2017

A project undertaken by the Friends of the Innamincka Reserves



Cordillo Downs Road, Innamincka Regional Reserve

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REPORT ON THE CORDILLO DOWNS ROAD BIRDS, MAMMALS & VEGETATION SURVEY 2017

INTRODUCTION

A. PROJECT COORDINATOR AND FIELD TEAM



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This project was carried out as a volunteer activity by members of the Friends of the Innamincka Reserves (FOIR). There was no external funding for the project.

B. BACKGROUND

In 2013 FOIR volunteers established a survey method which could be used to monitor the impacts of both short- and long-term changes in environmental conditions on populations of bird, mammal and vegetation species in the Innamincka Regional Reserve. Using this methodology, the volunteers obtained baseline survey data for an 80 km span of the Bore Track North¹. In subsequent years, similar surveys have been conducted along roads radiating out from Innamincka: the Coongie Road in 2014², the Old Strzelecki and Loop Tracks in 2015³ and now the Cordillo Downs Road in 2017. In 2016, high rainfall prevented access to the Reserve for a survey.

The Cordillo Downs Road links Birdsville and Innamincka. At the end of July in 2017, surveys were carried out along the northern part of the road within the Innamincka Regional Reserve. The survey route encompassed a range of habitat types within or on the edge of the Marqualpie Land System, including dry open woodlands and grasslands, dune systems and wetlands as well as gibber plains. While average rainfall is low (177 mm per annum), the Innamincka area is in a region of maximum rainfall variability for Australia. In 2010 this area experienced extreme rainfall in terms of scale and intensity, resulting in closure of several roads during 2010-2011 (Appendix IV). Following the extreme rainfall year in 2010, rainfall

¹ FOIR Bore Track North Survey Project Report 2013

² FOIR Coongie Road Survey Project Report 2014

³ FOIR Old Strzelecki and Loop Tracks Survey Project Report 2015

has been closer to average. A period of moderate rain early in 2017 resulted in some plant growth at the time, however this was not sustained as the country dried out again towards the middle of the year⁴.

The FOIR survey provides data for monitoring changes to populations of terrestrial birds, mammals and vegetation as the weather conditions change between ‘normal’, dry and ecological boom. It also enables assessment of the impacts of other environmental changes such as mining, road-making and grazing.

C. APPROACH

A series of survey transects was set up along an approximately 60 km section of the Cordillo Downs Road within the Innamincka Regional Reserve to establish a repeatable technique to monitor the distribution and abundance of bird species, mammals and vegetation with changes in climate and other impacts on the habitat. Transects covering differing vegetation types were sampled, providing invaluable baseline data for assessing future changes. Surveys were undertaken from 8 census stops, starting from near the northern boundary of the Reserve and finishing ~60 km south, near Policeman’s Tank. Census stops were 10 km apart except for census stop 5 which was ~5 km from adjacent census stops in order to sample the Red Mulga habitat at Dripie Creek.

Landscape conditions did not require modification of transect locations or routes during this survey except for the census stop selected to sample the Red Mulga habitat, however this may become necessary if the survey is repeated at a time when some of the flood channels are holding water.

D. OBJECTIVES

1. To collect data systematically for bird, mammal and plant species, at a series of transects spanning ~60 km in total along the Cordillo Downs Road within the Innamincka Regional Reserve.
2. To relate species occurrence to climatic and environmental variables.
3. To put in place a census strategy that can be repeated and potentially expanded in the future to detect the impacts of short- and long-term changes in climate and environment on populations and species.
4. To use a bird survey technique equivalent to a ‘fixed-route’ survey as specified for the Birdlife Australia Atlas project.
5. To present results quickly to provide the baseline data for ongoing research.
6. To use these data to facilitate further monitoring of the change in population diversity and abundance as the conditions change to drier or wetter or due to other environmental impacts such as mining and road-making.

E. PROGRAMME OF RESEARCH

Surveys were conducted on 27-29 July, 2017.

⁴ Bureau of Meteorology

METHODS

1. Survey overview and terminology

The road was surveyed using the method described below, travelling an average of 20-30 km per day along the road, with census stops every 10 km (except for one stop which was ~5 km from adjacent stops). The survey method is adapted from methodology used by Rob Clemens and Richard Fuller (School of Biological Sciences, University of Queensland) for similar surveys in outback SA. The survey technique is equivalent to a 'fixed-route' survey as specified for the Birdlife Australia Atlas project.

Key terminology (see also diagram in Fig. 1 below):

A **census stop** is one of the points placed at intervals along the road. The census stop forms a central point for conducting surveys in the surrounding habitat. The locations of all census stops are provided as GPS waypoints. If the exact location of the waypoint proves to be inaccessible, then the point is established along the road closest to the waypoint location.

A **corner point** is one of the corner points of a survey square.

A **transect** is one of the sides of a survey square.

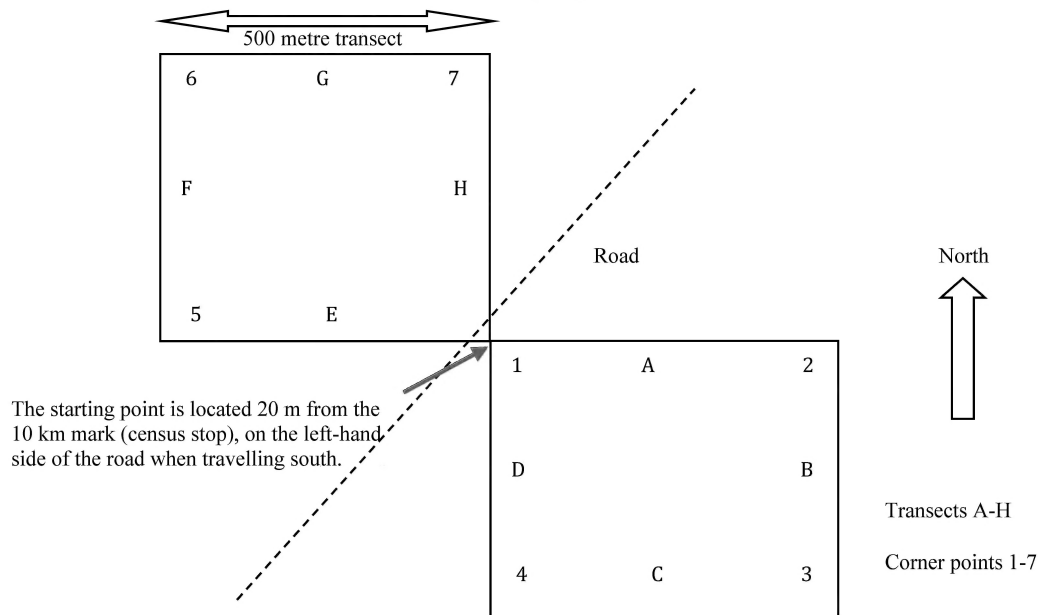


Fig. 1. Diagram of survey transect squares for each census stop

2. A typical day

A typical day commences at first light, travelling to the first census stop, surveying for 1.5-2 hours, and then moving to the next census stop for a further survey. Surveying finishes at around 11am-noon, when bird activity begins to decline noticeably. After a break during the heat of the day, surveys continue late in the afternoon when bird activity has increased again. Key equipment items for the surveys are listed in Appendix VI.

3. Communication

The team maintains contact using vehicle and hand-held UHF radios.

4. Briefing session

Before commencing surveys, leaders should brief the group on GPS technique for the survey and how to complete the survey sheets to ensure consistent data collection. The GPS co-ordinate system used is UTM and members should be familiar with how to select this on their GPS. A practice field session on using the GPS to complete a square is recommended. Two alternative methods for using the GPS to navigate a survey square are given in Appendix V.

5. Survey work at each census stop

The following protocol is adopted for the baseline survey and should be followed as closely as possible in future repeat surveys. If there are sufficient members in the group, half the group will take the east survey and the other half the west survey at each census stop.

(i) Upon arriving at a census stop, park the vehicle safely and place a hazard indicator (e.g. witch's hat) behind the cars if deemed necessary. Walk off the road 20 m from the census stop, left of the road when travelling south. Mark this starting location in the GPS (see diagram above, Fig. 1). Erect star dropper and attach metal tag with identifying detail e.g. 2015 FOIR 1 (see photos below). This is corner point 1 in Fig. 1.



(ii) Write the co-ordinates onto the survey sheet to ensure they are not lost and note the weather details. Note down the dominant habitat type in the area surrounding the starting point (corner point 1). Choose from gibber, grassland, dunes, shrubland, lignum, woodland, wetland. Record dominant species in the vegetation if known. Take a photo of the survey sheet and then take representative photographs of the habitat at the starting point, one towards the centre of the eastern transect square and one towards the centre of the western transect square. When walking around each transect square in a clockwise direction (as was done for this survey), representative habitat photos are also taken at each corner, first towards the right (into) and then the left (outside) the square. See photo labels in Appendix III.

(iii) Using a GPS to guide you, walk east for 500 m, conducting a line transect survey as you go (see methods below under 6. *Line Transect method* and *Appendix V. Using a GPS to navigate a transect square*). As each transect line follows grid north/south or east/west, maintaining a constant grid northing or easting as appropriate allows the navigator to stay on the transect line. If your route must deviate around obstacles etc., return to the transect once the obstacle has been passed.

(iv) At 500 m from the starting point, i.e. at corner point 2, write the co-ordinates onto the survey sheet, note the time, and take a photo of the survey sheet and then of the habitat towards the centre and outside of the transect square as before. Continue in this fashion following the scheme in the diagram until 8 line transects have been completed.

- (v) Aim to complete all the survey work for each census stop within 1.5-2 hours.

6. Line Transect method

(i) Walk slowly along the transect line, looking and listening for birds. Pay careful attention for birds that are flushed from ground cover as you approach. For each individual or group of birds seen, note down (a) the species including age and sex if determined, (b) the number of birds in the group, (c) whether you heard and/or saw the birds, and (d) any evidence of breeding or feeding activity. Use a separate survey sheet for each 500 m transect. Avoid double counting on adjacent transects.

(ii) If you need to stop to check birds do so but try to keep a roughly even averaged slow walking pace throughout the transect.

(iii) There is no maximum distance for recording birds – every bird you detect should be noted.

(iv) Note down any change in the dominant habitat type through which the transect passes (write across the line in the data collection columns). Choose from gibber, grassland, dunes, shrubland, lignum, woodland, wetland. Record dominant species in the vegetation if known. Take representative photographs of the habitat. Ensure there is a photo of the survey sheet prior to the habitat photo so it is always clear which transect the photo belongs to.

(v) Note (write across the line in the data collection columns) and photograph any mammal tracks or other traces and sightings of mammals. A photograph showing the gait of the animal/bird (i.e. set of prints) is useful for identification. A GPS reading for any significant sightings should be recorded.



Photograph of small mammal tracks with measuring card

(vi) Record any threats or impacting factors noted e.g. soil erosion, weeds e.g. Buffel Grass (*Cenchrus ciliaris*), Mimosa Bush (*Vachellia farnesiana*, previously *Acacia farnesiana*), feral animals, mining, road-making, grazing, fire, water/drainage disturbance, strong wind.

7. Incidental surveys while driving between census stops

(i) When driving between census stops, sightings such as a particularly large group of birds, something very rare, or anything in the environment that seems relevant to the aims of the study is recorded. These incidental surveys include a GPS reading followed by a 5 minute point count. The reason for the survey is noted e.g. “Cinnamon Quailthrush crossed the road” and the surveys entered as an incidental survey in the Birdlife Australia Atlas database (Birdata).

(ii) Any wetlands that are visible from the road are surveyed with a count of any water-birds present (2 ha/20 min, 500 m radius or 5 min incidental survey as appropriate). The GPS location is recorded and the wetland photographed.

(iii) A count of all mammals (feral and domestic) is recorded.

(iv) Make a note of any items left on or near the road such as tyres, garbage or equipment and record any threats (as described above, 6(vi)).

RESULTS AND DISCUSSION

A total of 8 census stops was established along the northern part of the Cordillo Downs Road within the Innamincka Regional Reserve. For this survey, the census stops were labelled CR01-8. The exact location of the census stops and the co-ordinates for the survey points are given in Appendix I.

A. BIRD SURVEY DATA

Bird surveys were conducted over three days, 27-29 July, 2017. Surveying was carried out before 12:00 or after 15:00 when conditions were cooler and winds generally not so strong. Details of the bird survey data are given in Appendix II and summaries of the data are presented in the tables below.

Table 1: Summary of numbers of birds observed for each census stop			
Date and start time	Census Stop	Number of species*	Number of individuals
27/07/2017 08:10	CR01	17	224
27/07/2017 10:30	CR02	7	17
28/07/2017 10:00	CR03	8	104
28/07/2017 07:45	CR04	13	113
27/07/2017 15:55	CR05	11	65
28/07/2017 15:40	CR06	11	79
29/07/2017 08:05	CR07	23	128
29/07/2017 10:25	CR08	16	161
Total		40	891
Average		13.25	111.4

* Excludes unidentified corvids

Table 2: Summary of counts by census stop for each bird species						
Species	No. of census stops where present	Total count	Min. count /stop when present	Max. count /stop when present	Average /stop when present	Average for all 8 stops
Emu	1	2	2	2	2.00	0.25
Stubble Quail	1	2	2	2	2.00	0.25
Black Kite	1	3	3	3	3.00	0.38
Wedge-tailed Eagle	1	1	1	1	1.00	0.25
Brown Falcon	6	11	1	3	1.83	1.38
Nankeen Kestrel	4	7	1	3	1.75	0.88
Crested Pigeon	4	13	2	4	3.25	1.63
Little Corella	3	44	2	40	14.67	5.50
Galah	2	13	4	9	6.50	1.63
Red-rumped Parrot	1	2	2	2	2.00	0.25
Bourke's Parrot	1	13	13	13	13.00	1.63
Bluebonnet	3	9	2	4	3.00	1.13
Horsfield's Bronze-cuckoo	1	2	2	2	2.00	0.25

Chestnut-rumped Thornbill	1	1	1	1	1.00	0.13
Banded Whiteface	1	5	5	5	5.00	0.63
Red-browed Pardalote	1	3	3	3	3.00	0.38
White-winged Fairywren	7	38	1	9	5.43	4.76
Spiny-cheeked Honeyeater	5	21	1	7	4.20	2.76
White-plumed Honeyeater	1	5	5	5	5.00	0.76
Singing Honeyeater	8	43	2	10	5.38	5.38
Yellow-throated Miner	4	63	1	23	15.75	7.88
Pied Honeyeater	1	3	3	3	3.00	0.38
Black Honeyeater	1	4	4	4	4.00	0.50
Crimson Chat	1	4	4	4	4.00	0.50
Orange Chat	1	2	2	2	2.00	0.25
Cinnamon Quail-thrush	2	4	2	2	2.00	0.50
Chirruping Wedgebill	4	12	1	5	3.00	1.50
Chestnut-crowned Babbler	2	9	3	6	4.50	1.13
Red-capped Robin	3	8	2	3	2.67	1.00
Willie Wagtail	3	9	2	5	3.00	1.13
Rufous Whistler	1	2	2	2	2.00	0.25
White-winged Triller	1	1	1	1	1.00	0.13
Black-faced Woodswallow	7	56	1	21	8.00	7.00
Grey Butcherbird	1	1	1	1	1.00	0.13
Australian Magpie	2	11	4	7	5.50	1.38
Australian Raven	4	11	1	3	2.75	1.38
Little Crow	5	12	1	4	2.40	1.50
White-backed Swallow	1	3	3	3	3.00	0.38
Fairy Martin	1	2	2	2	2.00	0.25
Zebra Finch	7	425	5	153	60.71	53.13
Crow/raven sp.	3	11	8	1	3.67	1.38
Total Species		40⁵				
Total Individuals		891				

The Cordillo Downs Road survey differed from those carried out in previous years in that no wetlands that contained water were encountered, although some clay pans would form ephemeral wetlands following rain events. These were all dry at the time of the survey. No wetland-dependent species (waterfowl and shorebirds) were recorded during the survey. Two of the census stops were close (within 1km) to dams or tanks created for stock watering. These tanks contained a limited amount of water which was helping to sustain some of the more water-dependent woodland birds. Policeman's Tank, about 1km south from census stop CR08 had two Pink-eared Ducks, one Hardhead and a Hoary-headed Grebe present when visited outside the survey time. A single White-backed Swallow was also seen at Policeman's Tank.

No species were present in the numbers that we might have expected. Rain events early in 2017 only gave a moderate boost to the growth and flowering of plants (Appendix IV). Apart from Zebra Finches that were present in reasonable numbers, mainly at sites closer to water, most species were present in low numbers.

⁵ Excludes species where full identification was not possible i.e. unidentified corvids

Singing Honeyeater was the only species present at all census stops. This species is resident in the region. Insects make up a large part of its diet allowing it to be less reliant on the erratic flowering of trees and shrubs.

Greatest bird density and species diversity was found at those census stops that had the greatest tree cover. These were close to ephemeral water courses e.g. Dripie Creek, or in the case of census stop CR01 included patches of *Corymbia* woodland.

Occurrence of honeyeaters was boosted by the presence of flowering *Hakea* which provided a food source for these species. Census stop CR06 had the greatest variety of honeyeaters including black and pied honeyeaters feeding on *Hakea*. These honeyeaters are nomadic, following the flowering of their food plants.

Lowest bird density occurred in the jumbled low dunes and sand plains of the Marqualpie System where the vegetation was dominated by grasses and low *Acacia* shrubs.

Fresh Australian Bustard tracks were observed at census stops CR02 and CR03. No bustards were recorded during the survey, but several individuals were seen over subsequent days near Innamincka.

B. HABITATS

The Marqualpie Land System is a large area of arid land which occupies the north-east corner of the Innamincka Regional Reserve. Much of this Land System is comprised of irregular, crescent shaped dunes especially in the north of the region and becoming lower towards the east. Further south the dunes give way to undulating sand or clay plains. The Cordillo Downs Road crosses the Marqualpie land in the north but further south follows the south-eastern edge of the system. The more southern census stops tended to cross this boundary. Some of the survey areas included stony rises. The soil type ranges from red siliceous dune sands to sandy loam to sand and clay. The area was severely burned around 5 years ago and has largely recovered.

The region generally experiences hot summers and mild dry winters. The driest months are July to September and the wettest months are January to March. The mean annual rainfall for Cordillo Downs (the nearest available weather records) is 167 mm. There had been earlier summer rains as evidenced by the extensive cover of grasses and forbs, now mainly drying off. No residual water was found in any of the areas surveyed, indicating that there had been no significant rains in recent months.

The surveys of July 2017 were carried out at 8 different locations along the Cordillo Downs Road, beginning in the north-east corner of the Innamincka Regional Reserve and heading south, loosely following the eastern boundary of the Reserve. The first two surveys in the far north were on low red dunes and hummock grasslands. The remainder were on low undulating sand or clay plains. Both land types are dissected by ephemeral watercourses of varying sizes.

One of the more significant creeks, Montkeleary Creek, drains water from the gibber tablelands to the north of the survey area into the north-east corner of the Reserve. The creek is lined pre-dominantly with Coolibah (*Eucalyptus coolabah*) and the associated riverine vegetation includes *Lysophilum gilvum*, *Acacia stenophylla* and *Eremophila bignoniflora*.

Sections of this creek harboured Noogoora Burr (*Xanthium strumarium*) and repeated attempts have been made by FOIR volunteers and National Parks staff to reduce its presence. The bank understorey was dominated by Queensland cane-grass (*Leptochloa digitata*), *Abutilon* sp. and Tall Scurf-pea (*Cullen australasicum*). Further south the undulating sand plains are dissected with smaller creeks that are frequently dominated by Red Mulga (*Acacia cyperophylla*) and scattered Coolibah (*Eucalyptus coolabah*).

In the north in the swales adjacent to the dunes or undulating sand plains, *Corymbia* low open woodland dominates the landscape, with *Aristida* grasslands being the dominant understorey and no mid-storey or shrub layer. The low dunes themselves were predominately covered in low open shrubs such as *Crotalaria eremaea* and *Grevillea stenobotrya*. The undulating sand plains are covered in hummock grasslands of Hard Spinifex (*Triodia basedowii*) and grasses such as *Aristida* sp. Further South, the undulating to flat sand or clay plains were covered in sparse to very sparse low open woodland of *Senna* sp. with some sporadic emergents such as whitewood (*Atalaya hemiglauca*) over scattered tussock grasses.

The occasional skink, dragon or other small reptile was seen on most surveys, mainly in hummock grassland areas, and their many tracks and burrows were frequent reminders of their presence. The majority of birds both in density and diversity were seen in the vegetation associated with water courses or in open *Corymbia* woodland (Table 3). Where *Hakea eyreana* was in flower, Pied and Black Honeyeaters were seen. Black-faced Woodswallows and Singing Honeyeaters were the most common birds on the open sand plains with scattered shrubs.

Photographs taken from the corner points and along the transects showing the habitats and flora are given in Appendix III.

Table 3: Bird species by vegetation type at census stops				
Census stop	Topography	Vegetation type		No. of bird species
CR01	Dunes and sand plain	Dunes: <i>Triodia</i> , <i>Crotalaria</i> , <i>Grevillea</i> , shrubland 30%	Sand plain: <i>Corymbia</i> woodland and grassland 70%	17
CR02	Undulating sand plain	<i>Triodia</i> /hummock grassland with open <i>Acacia</i> shrubland 100%		6
CR03	Undulating sand plain	Hummock grassland with <i>Acacia</i> shrubs and sparse Mulga woodland 100%		8
CR04	Undulating clay/sand plain with gibber rises. Nearby stock water tank.	Open shrubland with wire-grass understory 60%	Sparse grassland with <i>Senna</i> and low saltbushes 40%	12

CR05	Undulating clay/sand plain dissected by creek-lines	Open shrubland over grass/forbs understory 25%	Riparian Red Mulga with occasional Coolibah and River Redgums 75%	11
CR06	Undulating clay/sand plain	Grassland with sparse <i>Acacia</i> and <i>Hakea</i> 100%		11
CR07	Stony rises dissected by creek-lines	Heavily wooded Red Mulga and Eucalypt creek-line 30%	Low shrubland dominated by Chenopods 70%	23
CR08	Floodplain with gibber slopes and sandy rises	Chenopod and <i>Eremophila</i> grassland with sparse woodland extending into gibber in some areas 100%		15

C. FLORA

Although the Marqualpie Land System is largely ‘jumbled dunes’ the surveys were carried out along the Eastern Boundary of the Reserve where the dunes are low. Further south they become undulating sand or clay plains with the occasional stony or gibber rise. Some ephemeral water courses were also encountered. These arise in the higher stony country to the east and flow west before dissipating in the dune system.

In the north-east there was an extensive cover of summer tussock grasses such as *Aristida sp.* and some *Eragrostis sp.*, although they had long since dropped their seed and were rapidly drying out at the time of the survey in late July. However occasionally there was some evidence of more recent patchy winter rain which resulted in an understory of sporadic annual emergents such as *Senecio gregorii* in varying states of display ranging from bud to fruit.

Broadly there were four different floristic communities associated with the different landforms:

1. Low open woodland on the dunes and swales
2. Hummock grasslands on the undulating sand plains
3. Sparse shrublands and grasslands with some very sparse largely ephemeral herb fields that were usually associated with the clay plains and stony rises
4. Riverine communities of Coolibah and Red Mulga associated with ephemeral water courses.

There was often overlap of these vegetation types at the interface of different land forms. The riverine communities were the most floristically diverse as well as having the highest bird density and diversity.

1. Low Open Woodland

In the deep red sands of the taller dunes there was a very low open woodland formation dominated by *Grevillea stenobotrya* and *Acacia ligulata*. In other sections the dune crests were dominated by an open shrubland of *Crotalaria eremaea* and some Sandhill Cane-grass (*Zygochloa paradoxa*). The understory was dominated by *Triodia basedowii* with other emergents such as *Ptilotus sp.* and *Trichodesma zeylanica*.



Broad swales with loamy sands adjacent to the taller dunes were dominated by a low open woodland of sparse *Corymbia terminalis*. The shrub layer was almost absent apart from the occasional emergents of *Hakea eyreana*, *Atalaya hemiglauca* and *Eremophila longifolia*. The groundcover was dominated by *Aristida contorta* and some *Triodia basedowii*. Other annuals included *Rhodanthe floribunda*, *Calotis hispidula* and *Salsola tragus*. Occasionally a depression of cracking loamy mud was encountered containing a remnant cover of Nardoo (*Marsilea hirsuta*).

2. Open Hummock Grasslands

Open hummock grasslands were found in deep sand on very low dunes and undulating sand plains. Here there is an overstory of Hard Spinifex (*Triodia basedowii*). Other emergents scattered amongst the spinifex included *Senna sp.*, *Acacia ligulata* and a lot of *Rhodanthe floribunda* with scattered *Aristida sp.*, *Lepidium sp.*, *Calandrinia sp.* and *Senecio gregorii*.



3. Sparse Shrub and Grasslands to Very Sparse Herb Fields

Further south on the sand plains where the majority of the surveys were conducted, there were very low open woodland communities. These included *Acacia aneura*, *Hakea leucoptera*, *Atalaya hemiglauca*, usually with some scattered *Senna sp.* Other occasional emergents included *Hakea eyreana*, *Acacia tetragonophylla*, and small stands of bloodwood *Corymbia terminalis* and hop bush *Dodonaea sp.* The understory usually included some tussock grasses, *Aristida contorta*, *Aristida holathera* and scattered spinifex, *Triodia basedowii*, as well as forbs such as *Calotis plumulifera* and *Calotis hispidula*.

Midway along the Cordillo Downs Road around census stop CR04, clay pans were encountered with very low and very sparse (50%) vegetation cover while some of the stony/gibber rises contained as little as 30% vegetation cover. This consisted of an overstory of open grassland, generally *Aristida sp.* and to a lesser extent *Eragrostis sp.* mixed with scattered forbs such as *Calotis hispidula* and *Sclerolaena bicornis*. There was the very occasional emergent such as *Acacia tetragonophylla* and on the last survey, scattered *Eremophila macdonnellii* was observed.



4. Riverine Communities - Low Open Coolibah and Red Mulga

The ephemeral watercourses on the surveys were all dry. The larger creek-lines such as Dripie Creek and Candradecka Creek were dominated by low open Coolibah (*Eucalyptus coolabah*) woodland on the deeper sections and by Red Mulga (*Acacia cyperophylla*) in the shallower sections. Other sub-dominants included *Acacia stenophylla*, *Lysiphillum gilvum*, *Eremophila bignoniiflora*, *Atalaya hemiglauca*, *Santalum lanceolatum*, *Owenia acidula* and *Corymbia terminalis*. Further away from the creek-line there was a much lower and sparser cover of shrubs such as *Eremophila maculata* and *Senna sp.* Along some of the drainage channels and erosion lines on the clay plains, plants such as *Maireana aphylla* and *Eremophila maculata* were seen.



D. MAMMALS

1. Cattle

Cattle were heard at CR04 but there was no estimate of numbers. Heavy use by cattle was evident at CR05, CR06 and CR08. There were deeply cut tracks across the plains and signs of browsing on many of the shrubs at these census stops.

2. Feral horses/donkeys

No horses or donkeys were seen during the surveys but there were possible droppings observed at one census stop (CR02).

3. Rabbits

No rabbits were observed during the surveys, however rabbit warrens were recorded at CR01.

4. Fox and dingo

No fox or dingo were observed on the survey but a scat and footprints were noted. Dingos were heard calling at CR01. Dog prints along the road at CR05 may have been from a domestic dog as there were station workers at nearby cattle yards.

5. Cat

A feral cat was seen on one transect (CR01) and cat tracks were recorded at several locations on CR01. It should be noted that cats are a cryptic species and direct observations do not reflect their actual numbers within the environment.

6. Camel

Camel tracks were recorded at CR02. Fresh camel dung was seen at CR07 where it is likely that the animal(s) had been at the nearby tank for water and was probably still fairly close to the tank.

7. Kangaroos

Three Red Kangaroos were observed on transect A of census stop CR07. These animals were browsing in the low vegetation on the stony rise. These were the only kangaroos seen during the survey although several kangaroo resting hollows were seen in the shade of bushes.

8. Other mammals

No other mammals were seen on the survey. However tracks of small mammals (possibly the Long-haired Rat and/or hopping mouse) were frequently seen on soft sand and dunes. Small Long-haired Rat warrens generally appeared to be inactive although the animals may have been present in low numbers.

E. REPTILES AND AMPHIBIANS

Many small lizards and dragons and their tracks and holes were observed especially in hummock grass areas. In most cases it was not possible to obtain accurate identification however two species were prominent:

Central Military Dragon, *Ctenophorus isolepis* - common on the sand flats at CR02 where they were usually seen sheltering near *Triodia* tussocks.

Royal Ctenotus, *Ctenotus regius* - several individuals also seen at CR02; tended to occur more frequently in the *Aristida* grasslands.

No amphibians were recorded during the survey or at other times during the visit to this region.



Central Military Dragon



Royal Ctenotus

F. ARCHEOLOGICAL SITES

The Innamincka area has a long history of human occupation which has left traces over much of the landscape. Occasional stone flakes were seen during the survey, especially in ephemeral lakes e.g. at census stop CR05.

A scar tree was recorded on the south side of a bloodwood on transect G of CR05.

No European archeological relics were found.

An old survey point labelled 02 SP-AEH 219 was seen along transect D of CR06 (see photo in Appendix III).



G. THREATS AND POTENTIAL IMPACTING FACTORS

1. Cattle grazing

The whole of the survey area is subject to cattle grazing. Infrastructure related to the grazing industry was encountered during the survey. This included large tanks for stock watering near CR04, CR07 and CR08. There were also stockyards near CR06 and CR08. A north-south running fence-line passed through CR05.



Almost all grazing activity was encountered south of Leap Year Bore and Dam (between CR03 and CR04) although cattle were heard while at CR04. Grazing was heaviest close to water sources where much of the low plant growth had been removed. In some places trampling had occurred to the extent that it had obliterated ephemeral water courses and almost totally destroyed the algal crust and protective vegetation leaving loose sand subject to wind and water erosion. A very high level of cattle activity was evident along most creek-lines e.g. CR05, with some damage to riparian vegetation. Significant cattle tracks were encountered on CR06 and CR08 where cattle have been moving to/from water points.

The soils in this region have very weak structure without a robust cover of vegetation to hold them in place. As a result they are very susceptible to overgrazing as is evident close to water sources.

2. Soil Erosion

Most soil erosion that was seen was associated with vehicle tracks, particularly where they were close to or followed a water course. This was particularly obvious at CR08 where the old road line had become the major water course for an ephemeral creek.



There was significant but local erosion close to water points caused by the heavy concentrations of cattle.

Feral animals have the potential to cause erosion through their browsing, tracks and in the case of rabbits, their warrens. Feral animals appeared to be in fairly low numbers throughout the area.

3. Weeds

This area was relatively weed free compared to areas surveyed previously. There are a number of significant weeds that were considered during the survey.

(i) **Thorn apple** *Datura sp.* was found at Dripie Creek where there were a small number of plants along the creek-line. This species is spread by water so it is likely that there will be other plants both up and downstream of this currently minor infestation.

(ii) **Buffel Grass** *Cenchrus ciliaris* was recorded during the survey on census stop CR07 near the creek-line and road. This infestation is relatively small and hopefully isolated. This weed is common in the Innamincka area and downstream towards Coongie Lake. The creek-lines

and vehicle tracks in the survey area should be monitored for outbreaks which could easily be introduced on vehicles or cattle.

(iii) Mimosa Bush *Vachellia farnesiana* was recorded in small quantities at CR07 transect H. It is also known from Policeman's Tank, about 1km south of CR08 where it grew along the creek-line below the tank. It was not seen at this location during the time of this survey, however heavy use by cattle has destroyed most of the vegetation, including shrubs and small trees, in this area. Outside the survey area this species was recorded at Montkeleary Creek on the northern boundary of the Reserve.

(iv) Noogoora Burr *Xanthium strumarium* occurs at Montkeleary Creek where it is being spread by water. No instances of this weed were found during the survey, however creek-lines should be monitored for any occurrences.

4. Feral animals

The density of feral animals within the survey area appeared to be low. Tracks, droppings and other signs of several species were recorded.

(i) Camels - Camel tracks were observed at CR02, CR04 and CR07. Fresh camel scats were also found at CR07. There was a dry tank at CR04. It is likely that the camels had been visiting this potential water source. This was the first occurrence of camels on any of the surveys that we have carried out over the last five years.

(ii) Cats – A feral cat was seen on CR01 and cat tracks were seen at stops CR01 and CR05.

(iii) Horses and donkeys – No horses or donkeys were seen during the survey or on the days immediately prior to the survey when we were in the general area. Possible droppings were seen on one transect (census stop CR02).

(iv) Rabbits – Rabbit warrens were recorded on the sides of longitudinal dunes at CR01. These warrens appeared active although no rabbits were seen. Rabbit warrens were not recorded at other census stops.

(v) Mining and tourism development

Traces of old shot lines were found at several census stops. As the country was flat to only gently sloping these were not scoured out by water as happens on steeper country. In general the old shot lines were not having a major impact in this area and were gradually merging back into the surrounding country.

Litter was not a major problem in the survey area with just an occasional beer bottle etc. being found during surveys.

(vi) Vehicle tracks

Road grading is having a major impact along the road edges. Down-cutting of the road surface eventually creates a water course for low lying and sloping sections of the road. This then results in severe erosion rendering the road unusable after which a new road line is created and the process repeated. Consideration must be given as to how the road is maintained without causing major disruption to water flows and creating erosion hot spots.

There was little evidence of informal tracks. Those that were encountered appeared to be connected to station use or with oil and gas exploration. Where informal tracks are present they break the soil crust and open the soil to accelerated erosion from both wind and water.

(vii) Fire

Most of the area covered by this survey was burnt by extensive wildfires in 2011/12 following the breaking of the drought in 2010. Evidence of past fires was mainly in the form of burnt *Triodia* tussocks where the base with charred ends to the stems still remained. In some areas charred wood was found. There were also signs of regenerating shrubs and small trees such as Whitewood. Fire scars were recorded at CR01, CR02 and CR03. In general the area appeared to be recovering well from these fires.

(viii) Irrigation and water use

This area is not part of the Cooper Floodplain but consists of higher land and minor catchments. The main creek in the area is Montkeleary Creek which flows in a south westerly direction from its source on Cordillo Downs to terminate in the dune systems of the Marqualpie. It does not reach the terminal lakes of the north branch of Cooper Creek. A couple of smaller creeks e.g. Dripie Creek, flow from east to west and crossed some of the census stops.

The main water-related impact in this area is the increase in cattle water points such as tanks and bores. These result in increased browsing pressure from cattle and other animals with consequent impacts on the soils and vegetation as discussed above.

CONCLUSIONS

This survey is the fourth in a series conducted by FOIR volunteers to obtain baseline data on birds, mammals and vegetation species in the Innamincka Regional Reserve. Surveys have now been conducted along several road routes, essentially radiating out from the vicinity of Innamincka: the Bore Track North in 2013, the Coongie Road in 2014, the Old Strzelecki and Loop Tracks in 2015 and now the Cordillo Downs Road in 2017.

As for the previous surveys, the data collected for this survey document ecologically important areas with extensive floral attributes and valuable habitats for resident and nomadic faunal species. The surveys also point to current and potential threats to the integrity of these ecosystems that require ongoing surveillance. The survey data and information gathered provide a valuable resource for development of management plans for the region. It is recommended that repeat surveys be conducted at least every 5 years to detect trends in wildlife numbers and habitat condition and to assess the impacts of both short- and long-term changes in environmental conditions on the flora and fauna of the Innamincka Regional Reserve.

APPENDIX I – LOCATION OF CENSUS STOPS

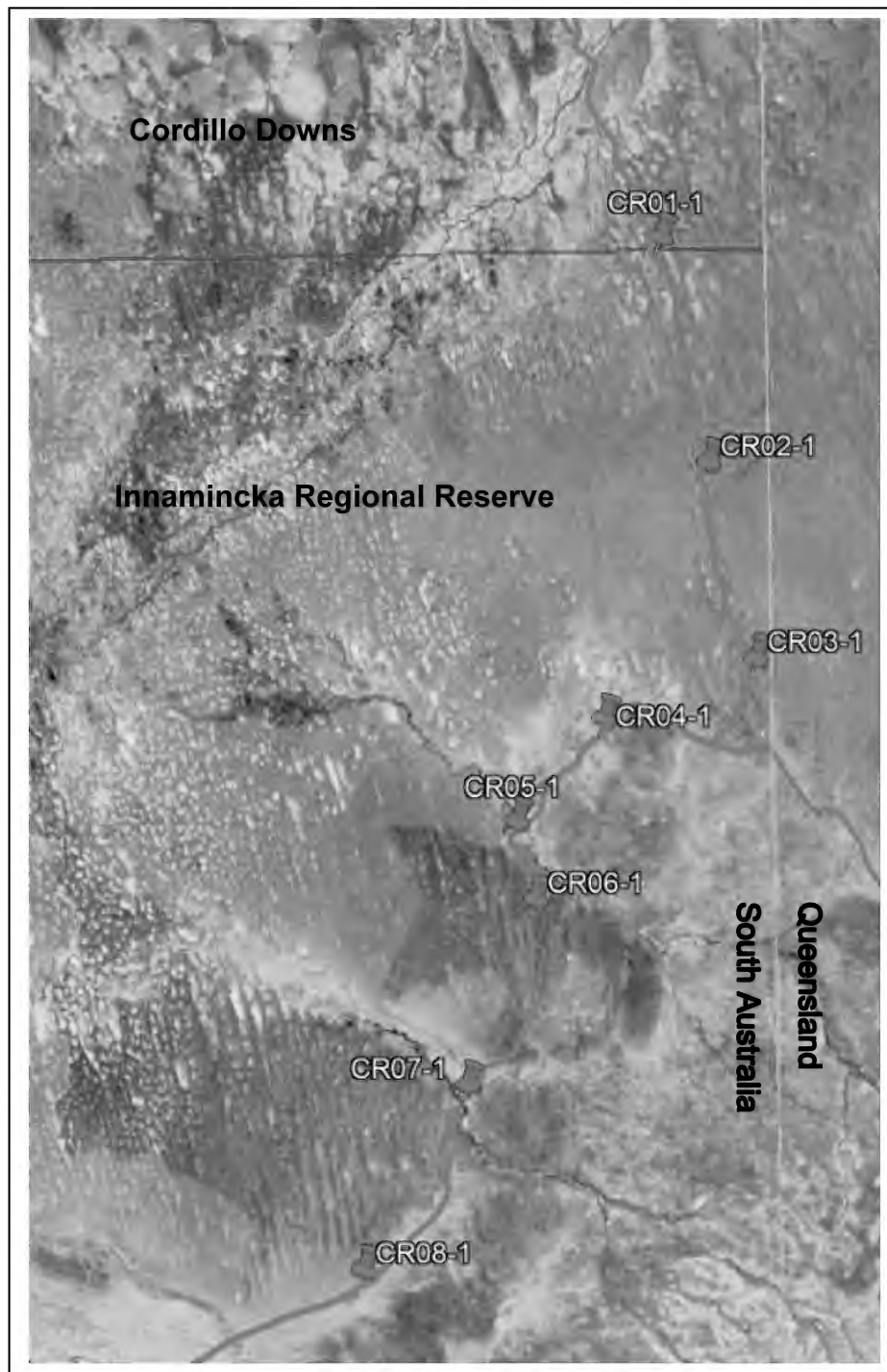
A. CENSUS STOP AND SURVEY POINT CO-ORDINATES

The following table lists the co-ordinates for each census stop. The co-ordinate system used is UTM. The census stops are also shown on the following Map.

Census Stop	Corner Point	AMG zone	Easting	Northing
CR01	1	54J	494941	7026920
	2	54J	495441	7026920
	3	54J	495441	7026420
	4	54J	494941	7026420
	5	54J	494441	7026920
	6	54J	494441	7027420
	7	54J	494941	7027420
CR02	1	54J	496951	7016692
	2	54J	497451	7016692
	3	54J	497451	7016192
	4	54J	496951	7016192
	5	54J	496451	7016692
	6	54J	496451	7017192
	7	54J	496951	7017192
CR03	1	54J	498953	7007863
	2	54J	499453	7007863
	3	54J	499453	7007363
	4	54J	498953	7007363
	5	54J	498453	7007863
	6	54J	498453	7008363
	7	54J	498953	7008363
CR04	1	54J	492021	7005245
	2	54J	492521	7005245
	3	54J	492521	7004745
	4	54J	492021	7004745
	5	54J	491521	7005245
	6	54J	491521	7005745
	7	54J	492021	7005745
CR05	1	54J	487983	7000695
	2	54J	488483	7000695
	3	54J	488483	7000195
	4	54J	487983	7000195
	5	54J	487483	7000695
	6	54J	487483	7001195
	7	54J	487983	7001195
CR06	1	54J	488787	6997135
	2	54J	489287	6997135
	3	54J	489287	6996635
	4	54J	488787	6996635

Census Stop	Corner Point	AMG zone	Easting	Northing
	5	54J	488287	6997135
	6	54J	488287	6997635
	7	54J	488787	6997635
CR07	1	54J	485550	6988804
	2	54J	486050	6988804
	3	54J	486050	6988304
	4	54J	485550	6988304
	5	54J	485050	6988804
	6	54J	485050	6989304
	7	54J	485550	6989304
CR08	1	54J	480698	6980551
	2	54J	481198	6980551
	3	54J	481198	6980051
	4	54J	480698	6980051
	5	54J	480198	6980551
	6	54J	480198	6981051
	7	54J	480698	6981051

B. MAP SHOWING CENSUS STOP LOCATIONS ALONG THE CORDILLO DOWNS ROAD



Source: VantagePoint™/DigitalGlobe™ overlaid with FOIR census stop co-ordinates



APPENDIX II - BIRD SURVEY DATA

Combined data for all 8 transects at each census stop

Date and time	Census Stop	Species	Seen/ Heard	Number	Co-ordinates
27/07/2017	CR01	Australian Magpie	Seen	4	54 J
St. 08:10		Australian Raven	Seen	2	494941
Fin. 09:45		Australian Raven	Heard	1	7026920N
		Black Kite	Seen	3	
		Black-faced Woodswallow	Heard	1	
		Black-faced Woodswallow	Seen	3	
		Crested Pigeon	Seen	4	
		Bluebonnet	Seen	2	
		Grey Butcherbird	Heard	1	
		Little Corella	Heard	1	
		Little Corella	Dead	1	
		Little Crow	Heard	1	
		Red-browed Pardalote	Heard	2	
		Red-browed Pardalote	Seen	1	
		Red-capped Robin	Seen	3	
		Singing Honeyeater	Heard	1	
		Singing Honeyeater	Seen	6	
		Spiny-cheeked Honeyeater	Heard	1	
		Spiny-cheeked Honeyeater	Seen	3	
		Stubble Quail	Seen	2	
		White-winged Fairywren	Seen	4	
		Yellow-throated Miner	Heard	1	
		Yellow-throated Miner	Seen	21	
		Zebra Finch	Seen	153	

27/07/2017	CR02	Brown Falcon	Seen	2	54J
St. 10:30		Nankeen Kestrel	Seen	2	496951E
Fin. 11:55		Singing Honeyeater	Seen	2	7016692N
		Spiny-cheeked Honeyeater	Heard	1	
		White-winged Fairywren	Seen	5	
		Zebra Finch	Heard	1	
		Zebra Finch	Seen	4	

28/07/2017	CR03	Black-faced Woodswallow	Seen	6	54J
St. 10:00		Brown Falcon	Seen	1	498953E
Fin. 11:05		Chestnut-crowned Babbler	Seen	3	7007863N
		Corvid	Seen	1	
		Little Crow	Heard	1	
		Little Crow	Seen	4	

		Nankeen Kestrel	Seen	1	
		Singing Honeyeater	Heard	2	
		Singing Honeyeater	Seen	1	
		White-winged Fairywren	Heard	1	
		Zebra Finch	Seen	82	

28/07/2017	CR04	Australian Raven	Seen	3	54J
St. 07:45		Black-faced Woodswallow	Seen	3	492021E
Fin. 09:35		Brown Falcon	Seen	2	7005247N
		Chestnut-rumped Thornbill	Seen	1	
		Chirruping Wedgebill	Heard	2	
		Chirruping Wedgebill	Seen	5	
		Corvid	Seen	8	
		Crested Pigeon	Seen	2	
		Fairy Martin	Seen	2	
		Singing Honeyeater	Heard	2	
		Singing Honeyeater	Seen	2	
		White-backed Swallow	Seen	3	
		White-winged Fairywren	Heard	1	
		White-winged Fairywren	Seen	6	
		Willie Wagtail	Seen	2	
		Yellow-throated Miner	Seen	17	
		Zebra Finch	Heard	1	
		Zebra Finch	Seen	51	

27/07/2017	CR05	Black-faced Woodswallow	Heard	1	54J
St. 15:55		Black-faced Woodswallow	Seen	6	487983E
Fin. 17:20		Brown Falcon	Seen	1	7000695N
		Chestnut-crowned Babbler	Seen	6	
		Cinnamon Quail-Thrush	Heard	2	
		Crested Pigeon	Seen	3	
		Bluebonnet	Seen	4	
		Emu	Seen	2	
		Singing Honeyeater	Seen	10	
		Spiny-cheeked Honeyeater	Heard	3	
		Spiny-cheeked Honeyeater	Seen	2	
		Willie Wagtail	Seen	2	
		Yellow-throated Miner	Heard	1	
		Yellow-throated Miner	Seen	22	

28/07/2017	CR06	Australian Raven	Seen	1	54J
St. 15:40		Black Honeyeater	Seen	4	489289E
Fin. 16:55		Black-faced Woodswallow	Seen	1	6996636N
		Brown Falcon	Seen	3	
		Chirruping Wedgebill	Seen	2	

		Little Crow	Seen	1	
		Pied Honeyeater	Seen	3	
		Red-capped Robin	Seen	3	
		Singing Honeyeater	Seen	7	
		White-winged Fairywren	Seen	9	
		Zebra Finch	Heard	1	
		Zebra Finch	Seen	47	

29/07/2017	CR07	Australian Magpie	Heard	1	54J
St. 08:05		Australian Magpie	Seen	6	485650E
Fin. 09:50		Australian Raven	Heard	1	6988804N
		Australian Raven	Seen	3	
		Black-faced Woodswallow	Seen	21	
		Bourke's Parrot	Seen	13	
		Brown Falcon	Seen	1	
		Chirruping Wedgebill	Heard	1	
		Cinnamon Quail-Thrush	Seen	2	
		Crested Pigeon	Heard	1	
		Crested Pigeon	Seen	3	
		Bluebonnet	Seen	3	
		Galah	Seen	4	
		Horsfield's Bronze Cuckoo	Heard	1	
		Horsfield's Bronze Cuckoo	Seen	1	
		Little Corella	Seen	2	
		Little Crow	Heard	1	
		Nankeen Kestrel	Seen	3	
		Red-capped Robin	Heard	1	
		Red-capped Robin	Seen	1	
		Red-rumped Parrot	Seen	2	
		Rufous Whistler	Seen	1	
		Singing Honeyeater	Heard	2	
		Singing Honeyeater	Seen	1	
		Spiny-cheeked Honeyeater	Heard	3	
		Spiny-cheeked Honeyeater	Seen	4	
		White-plumed Honeyeater	Heard	1	
		White-plumed Honeyeater	Seen	4	
		White-winged Fairywren	Seen	4	
		Willie Wagtail	Heard	1	
		Willie Wagtail	Seen	4	
		Zebra Finch	Heard	4	
		Zebra Finch	Seen	24	

29/07/2017	CR08	Banded Whiteface	Seen	5	54J
St. 10:08		Black-faced Woodswallow	Seen	14	480698E
Fin. 11:45		Chirruping Wedgebill	Heard	2	6980551N

		Corvid	Seen	2	
		Crimson Chat	Seen	4	
		Galah	Seen	9	
		Little Corella	Seen	40	
		Little Crow	Seen	4	
		Nankeen Kestrel	Seen	1	
		Orange Chat	Seen	2	
		Singing Honeyeater	Heard	3	
		Singing Honeyeater	Seen	4	
		Spiny-cheeked Honeyeater	Heard	2	
		Spiny-cheeked Honeyeater	Seen	2	
		Wedge-tailed Eagle	Seen	1	
		White-winged Fairywren	Heard	1	
		White-winged Fairywren	Seen	7	
		White-winged Triller	Seen	1	
		Yellow-throated Miner	Seen	1	
		Zebra Finch	Heard	1	
		Zebra Finch	Seen	55	

APPENDIX III - PHOTOGRAPHIC AND HABITAT RECORDS









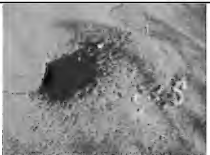






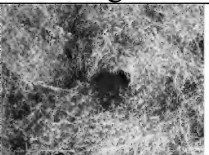
Original photographs are available from FOIR for analysis if required.



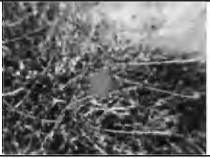








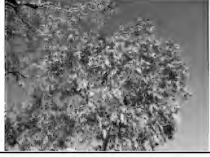
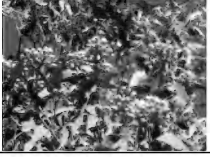


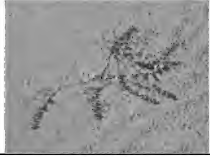




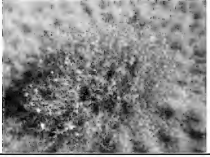
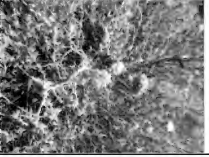


Census stop 1 Date: 27-07-2017 Commenced: 08:10






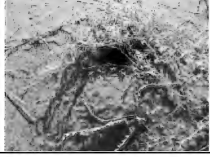

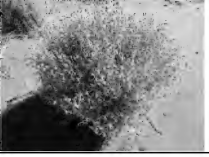












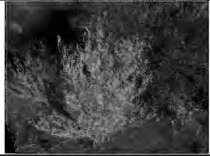


Weather: Calm, mild















Number of observers: 6

Habitat: *Corymbia* woodland, dunes, undulating sand plain








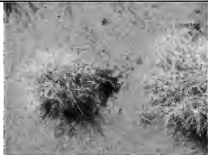




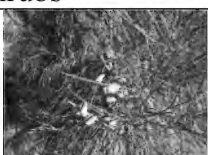



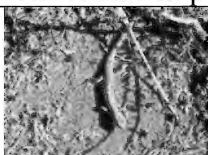
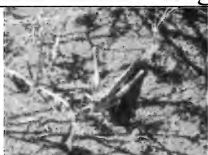
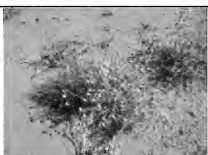

Corner point 1	Right: 	Left: 		
	Habitat: <i>Corymbia</i> woodlands, undulating sand plain with hummock grassland			
Transect A				
	Hummock grassland, <i>Triodia</i> on dune	Scat (fibrous)	Animal tracks	<i>Grevillea stenobotrya</i> , Sandhill Spider-flower
				
	Animal tracks	Dune with <i>Crotalaria</i> . Sand plain beyond	Lizard? burrow	Whitewood and <i>Corymbia</i>
Corner point 2	Right: 	Left: 		
	Habitat: <i>Corymbia</i> woodlands, undulating sand plain with hummock grassland			
Transect B				
	<i>Hakea eyreana</i>	Bloodwood regrowth from burnt stump	Sand plain with <i>Corymbia</i> and grassland	Mammal? hole





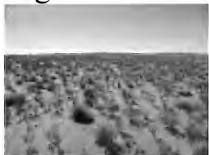



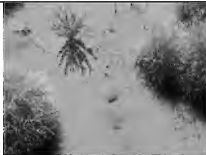
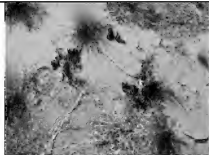

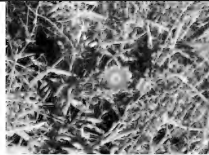

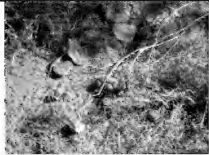


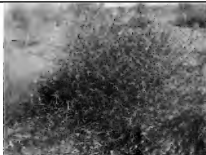





				
	<i>Corymbia terminalis</i> , Bloodwood	<i>Calotis erinacea</i> , Tangled Burr-daisy		North-south running dune with swale
				
	Small mammal tracks	Small mammal and bird tracks	<i>Triodia</i> hummock grassland	<i>Aristida</i> grassland and dead forbs
Corner point 3	Right: 	Left: 		
Habitat: Sand plain with hummock grassland and scattered <i>Corymbia</i>				
Transect C				
	<i>Corymbia terminalis</i> , Bloodwood			Small mammal tracks
				
	Lizard (dragon) tracks	<i>Euphorbia</i> sp	Snake or legless lizard track	Sand plain
				
	Lizard? hole	<i>Senna artemisioides</i>	<i>Ptilotus sessilifolius</i> , Crimson Foxtail	
Corner point 4	Right: 	Left: 		
Habitat: Sand plain with <i>Aristida</i> hummock grassland				





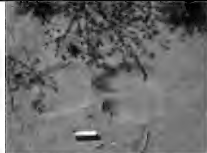
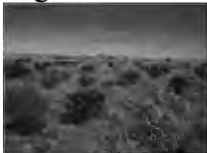


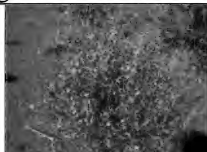
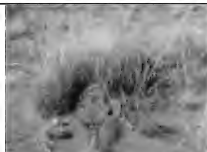
Transect D				
	Termite mound	<i>Triodia</i> and small mammal tracks	Zebra Finches in dead <i>Hakea</i>	<i>Triodia</i> sp.
				
	<i>Senna artemisioides</i>	Reptile or small mammal burrow	<i>Ptilotus sessilifolius</i> , Crimson Foxtail	<i>Isotropis wheeleri</i> , Wheeler's Lamb-poison
				
	<i>Isotropis wheeleri</i> , Wheeler's Lamb-poison	<i>Rutidosia helichrysoides</i> ssp. <i>helichrysoides</i> , Grey Wrinklewort		Termite mound with seed husks
Transect E				
	Sand plain with scattered trees	Road and <i>Corymbia</i> woodland	Dune with open grassland	Small mammal and snake/legless lizard tracks
				
	<i>Dicrastylis lewellinii</i>			
Corner point 5	Right: 	Left: 		
	Habitat: Undulating sand plain/dunes with hummock grassland and <i>Corymbia</i>			
Transect F				
	<i>Grevillea stenobotrya</i> , Sandhill Spider-flower	<i>Crotalaria eremaea</i> , Loose-flowered Rattlepod	Sand plain between dunes	<i>Trichodesma zeylanicum</i> , Cattlebush

				
	Tracks: bird, small mammal, fox/cat	Fenceline across sand plain	Bird tracks	Macropod scats
Corner point 6	Right: 	Left: 		
	Habitat: <i>Corymbia</i> woodlands, undulating sand plain with hummock grassland			
Transect G				
	<i>Hakea eyreana</i>			Termite mound
Corner point 7	Right: 	Left: 		
	Habitat: Sand plain with <i>Corymbia</i> and scattered shrubs			
Transect H				
	Sand plain	Hummock grassland		

Census stop 2 Date: 27-07-2017 Commenced: 10:30
Weather: Warm, light breeze
Number of observers: 6
Habitat: *Triodia*, hummock grassland

Corner point 1	Right: 	Left: 		
	Habitat: Sand plain with <i>Triodia</i> hummock grassland and scattered shrubs			
Transect A				
	<i>Triodia</i> grassland	Bustard tracks	Fox/cat tracks	Camel tracks
				
	<i>Hakea eyreana</i>	<i>Triodia</i> and <i>Calandrinia</i>		
Corner point 2	Right: 	Left: 		
	Habitat: Hummock grassland with low shrubs			
Transect B				
	Low Senna and Chenopod shrubs	<i>Grevillea stenobotrya</i> , Sandhill Spider-flower	Whitewood and Chenopod shrubs	
Corner point 3	Right: 	Left: 		
	Habitat: Sand plain with hummock grassland and fire scars			
Transect C				
	<i>Ctenotus regius</i> , Royal Ctenotus	Locust	<i>Lepidium sp.</i>	<i>Aristida</i> tussocks

				
	<i>Ctenophorus isolepis</i> , Central Military Dragon		Intact grassland with mixed shrub overstorey	<i>Calandrinia balonensis</i> , Broad-leafed Parakeelya
Corner point 4	Right: 	Left: 		
Habitat: Hummock grassland with low shrubs				
Transect D				
	Bustard tracks	Open hummock grassland	Scorpion hole and bird tracks	Regrowth after fire
				
	Small mammal burrow	<i>Calandrinia balonensis</i> , Broad-leafed Parakeelya	Dingo scats	Horse/Donkey? droppings
Transect E				
	<i>Triodia</i> hummock grassland	<i>Crotalaria eremaea</i> , Loose-flowered Rattlepod	<i>Scaevola spinescens</i>	Bustard tracks
Corner point 5	Right: 	Left: 		
Habitat: Undulating sand plain/dune with <i>Triodia</i> and low shrubs				
Transect F				
	<i>Grevillea juncifolia</i>	Sand plain with hummock grasses and <i>Senna</i>		

Corner point 6	Right: 	Left: 		
	Habitat: Sand plain with hummock grassland			
Transect G				
	Whitewood regeneration	<i>Calandrinia balonensis</i> , Broad-leafed Parakeelya	Camel tracks	
Corner point 7	Right: 	Left: 		
	Habitat: Hummock grassland with low shrubs and forbs			
Transect H				
	<i>Acacia sp.</i>	<i>Lepidium sp.</i> , Peppercress	Active small mammal burrow under cane-grass	

Census stop 3




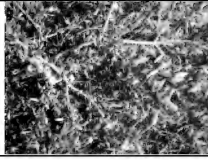







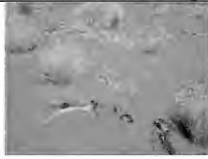
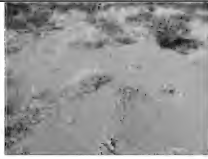



Date: 28-07-2017





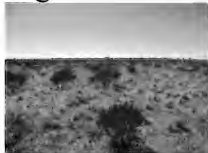

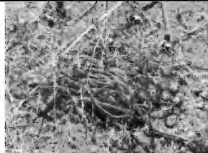








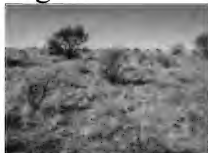



Commenced: 10:00





Weather: Warm, calm

Number of observers: 6

Habitat: Hummock grassland, scattered Mulga

Corner point 1	Right: 	Left: 		
	Habitat: Sand plain, hummock grassland with scattered Mulga			
Transect A				
	Small mammal tracks	<i>Scaevola spinescens</i>	<i>Eremophila maculata</i> , Spotted Fuchsia	Scattered shrubs including <i>Eremophila</i> and Whitewood
				
	<i>Atalaya hemiglauca</i> , Whitewood regeneration after fire	Bustard tracks	Pig or goat? tracks	
Corner point 2	Right: 	Left: 		
	Habitat: Sand plain with <i>Triodia</i> hummock grassland and scattered shrubs			
Transect B				
	Burnt wood	Fire scars in <i>Triodia</i>	Small mammal holes	
Corner point 3	Right: 	Left: 		
	Habitat: Sand plain and clay pan with hummock grassland and shrubs			

Transect C				
	Sand plain vegetation	<i>Eremophila</i> with seeds	<i>Trachymene glaucifolia</i> , Wild Parsnip	Tracks
Corner point 4	Right: 	Left: 		
	Habitat: Sand plain with low tussock grassland and scattered shrubs			
Transect D				
	<i>Calandrinia</i> sp.	<i>Sclerolaena</i> sp.		
Transect E				
	Undulating grassy sand plain with scattered trees			
Corner point 5	Right: 	Left: 		
	Habitat: Sand plain dominated by <i>Triodia</i> hummock grassland			
Transect F				
	Zebra Finch nests	Zebra Finch nest		
Corner point 6	Right: 	Left: 		
	Habitat: Sand plain with grasses and scattered trees			
Transect G				
	<i>Solanum ellipticum</i>	<i>Senna pleurocarpa</i> , Smooth Cassia		

Corner point 7	Right: 	Left: 		
	Habitat: Sand plain with grasses and scattered shrubs and trees			
Transect H				
	Termite mound	<i>Salsola australis</i>		

Census stop 4




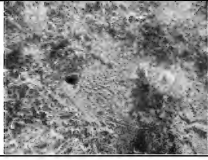

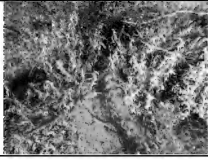









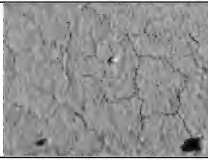

Date: 28-07-2017















Commenced: 07:45





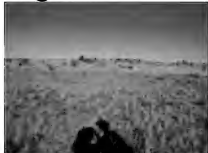



Weather: Mild, calm

Number of observers: 6

Habitat: Sand plain grassland, 50% cover, open shrubs

Corner point 1	Right: 	Left: 		
	Habitat: Sand plain grassland with a few shrubs. Approx. 50% ground cover			
Transect A				
	Small mammal tracks	Small mammal tracks into hole	Grassland with <i>Acacia sp.</i>	Small mammal tracks into hole
				
	Algal crust	Tussock grassland		
Corner point 2	Right: 	Left: 		
	Habitat: Gibber rise with open grassland and low saltbushes			
Transect B				
	Gibber rise with open grassland and low saltbushes			
Corner point 3	Right: 	Left: 		
	Habitat: Gibber rise with open grassland and low shrubs			
Transect C				
	Kangaroo resting place	Clay pan and grassland	Stone flakes	Kangaroo tracks

				
	Creek-bed with small mammal tracks			
Corner point 4	Right: 	Left: 		
Habitat: Clay plain with open grasses and shrubs				
Transect D				
	Camel tracks	Stock watering point		
Transect E				
	Sand plain with scattered shrubs	Small mammal track	<i>Atalaya hemiglauca</i> , Whitewood	
Corner point 5	Right: 	Left: 		
Habitat: Clay plain with sparse covering of grasses and forbs				
Transect F				
	<i>Acacia tetragonophylla</i> , Dead Finish	Reptile hole beneath <i>Eragrostis</i>		
Corner point 6	Right: 	Left: 		
Habitat: Undulating clay/sand plain with sparse <i>Eragrostis sp.</i> and low shrubs				

Transect G				
	<i>Eremophila maculata</i> and <i>Sclerolaena bicornis</i>	Clay pan with dried <i>Marsilea</i> sp., Nardoo	<i>Sclerolaena bicornis</i> , Goathead Burr	<i>Hakea leucoptera</i> , Needlewood
Corner point 7	Right: 	Left: 		
	Habitat: Undulating clay plain with open grassland and woolly-headed burr-daisy			
Transect H				
	Open shrubland	<i>Eremophila</i> sp.		

Census stop 5








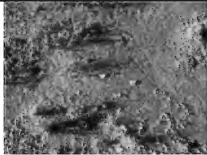













Date: 27-07-2017





















Commenced: 15:55




Weather: Hot, calm

Number of observers: 6

Habitat: Open shrubland

Corner point 1	Right: 	Left: 		
	Habitat: Sand plain with scattered trees, open shrubland and grassland			
Transect A				
	<i>Acacia cyperophylla</i> , Red Mulga			<i>Corymbia terminalis</i> , Bloodwood
				
	Cattle tracks	Stone flakes	Erosion scars on sand plain	
Corner point 2	Right: 	Left: 		
	Habitat: Open <i>Acacia</i> scrubland with grassy understorey			
Transect B				
	<i>Acacia</i> woodland	<i>Acacia cyperophylla</i> , Red Mulga	Clay plain above creek-line	
Corner point 3	Right: 	Left: 		
	Habitat: Clay/sand plain with open grassland			
Transect C				
	Grassland with low salt bushes	Clay plain	Clay pan with cattle prints	Cattle tracks across clay pan

Corner point 4	Right: 	Left: 		
Habitat: Gibber plain with sparse grassland				
Transect D				
	Fence line immediately west of transect	Emu	<i>Hakea eyreana</i>	<i>Acacia sp.</i>
Transect E				
	Grassland with Mulga woodland	Open grassland with <i>Acacia</i> and <i>Senna</i>	Fence line through western quadrant	Small mammal tracks
Corner point 5	Right: 	Left: 		
Habitat: Undulating sand plain with tall wire-grass				
Transect F	No photos			
Corner point 6	Right: 	Left: 		
Habitat: Creek-line with small trees. Open shrubland on nearby plain				
Transect G				
	Erosion channels near creek		<i>Owenia acidula</i> , Sour Plum	Mulga woodland along creek-line
Corner point 7	Right: 	Left: 		
Habitat: Open Whitewood woodland with grassy understorey				

Transect H				
	<i>Acacia aneura</i> , Mulga	Fence line near creek	<i>Acacia cyperophylla</i> , Red Mulga	

Census stop 6





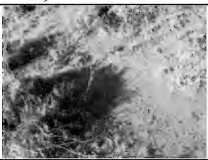
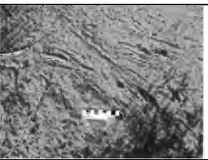





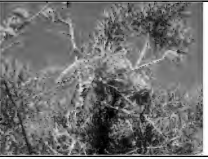



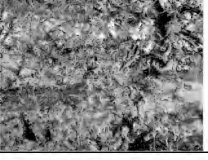




Date: 28-07-2017














Commenced: 15:40



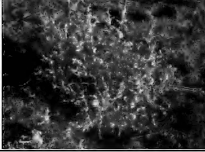
Weather: Hot, light breeze

Number of observers: 6










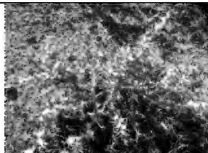

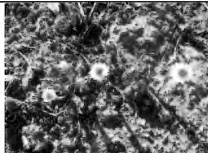


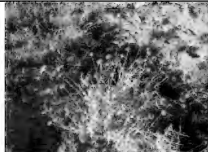

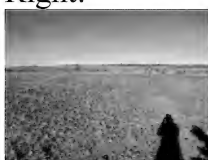

Habitat: Clay plain, hummock grassland, scattered Mulga/Dead Finish




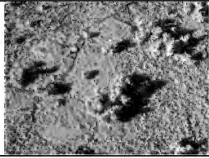




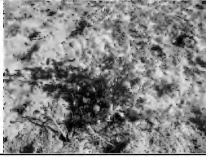
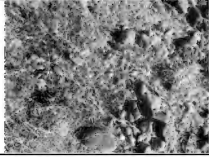
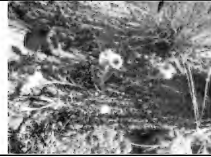
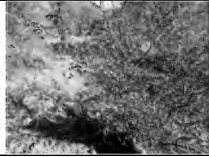

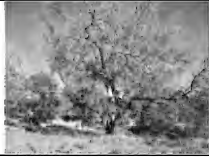


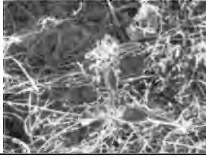






Corner point 1	Right: 	Left: 		
	Habitat: Clay plain with hummock grassland, scattered Mulga and Dead Finish			
Transect A				
	<i>Triodia</i> with <i>Acacia</i> spp.	Old unburnt <i>Triodia</i>	Small mammal tracks	Tracks
Corner point 2	Right: 	Left: 		
	Habitat: Clay plain with wire-grass and scattered shrubs			
Transect B				
	Open grassland with Dead Finish	<i>Acacia tetragonophylla</i> , Dead Finish	<i>Hakea eyreana</i>	<i>Hakea eyreana</i>
				
	Cattle pad	<i>Corymbia terminalis</i> , Bloodwood	Fresh cattle droppings and tracks	<i>Hakea eyreana</i>
Corner point 3	Right: 	Left: 		
	Habitat: Sandy rise with long unburnt <i>Triodia</i>			
Transect C				
	<i>Senna</i> and <i>Acacia</i> shrub land	Cordillo Downs Rd		


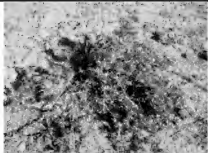





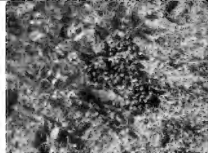







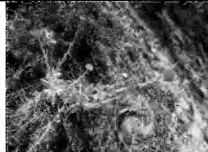


Corner point 4	Right: 	Left: 		
	Habitat: Grassland with <i>Senna</i> and <i>Acacia</i> shrubs bisected by Cordillo Downs Rd			
Transect D				
	Erosion gully	Brown Falcon	Unknown survey point @ 200m	Cordillo Downs Rd
Transect E				
	<i>Acacia aneura</i> , Mulga	Sand plain with scattered Mulga		
Corner point 5	Right: 	Left: 		
	Habitat: Clay plain with <i>Triodia</i> and Dead Finish			
Transect F				
	<i>Euphorbia tanensis</i> ssp <i>eremophila</i>			
Corner point 6	Right: 	Left: 		
	Habitat: Grassland with sparse shrubs on undulating sand plain			
Transect G	No photos			






Corner point 7	Right: 	Left: 		
	Habitat: Undulating sand plain with <i>Triodia</i> hummock grassland and low shrubs			
Transect H				
	<i>Dissocarpus paradoxus</i> , Cannonball			

Census stop 7 Date: 29-07-2017 Commenced: 08:05
Weather: Mild, calm
Number of observers: 6
Habitat: Gibber plain beside creek with Red Mulga



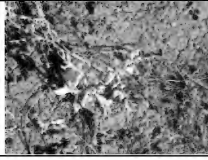



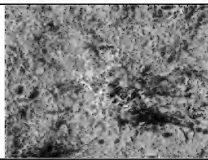

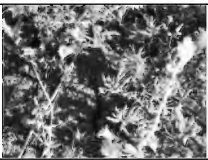

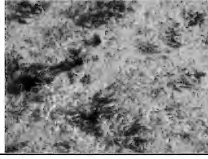





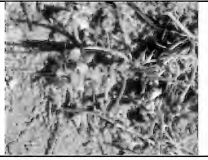


Corner point 1	Right: 	Left: 		
	Habitat: Gibber plain, nearby creek with Red Mulga			
Transect A				
	Bourke's Parrot	Creek-bed with Red Mulga	Old Red Mulga, <i>Acacia cyperophylla</i>	Rocky outcrops along creek bank
				
	Creek-line through gibber plain	Cattle tracks along creek-line	<i>Ptilotus sessilifolius</i> , Crimson Foxtail	<i>Sclerolaena bicornis</i> , Goathead Burr
				
	<i>Senna artemisioides</i> ssp <i>oligophylla</i> , Limestone Cassia	<i>Rhodanthe floribunda</i> , White Paper-daisy	Red Kangaroos on gibber plain	Gibber plain with low saltbush and grasses
				
	<i>Leiocarpa leptolepis</i> , Pale Plover Daisy	<i>Euphorbia tannensis</i>		
Corner point 2	Right: 	Left: 		
	Habitat: Gibber rise, 30% vegetation, mainly low saltbush			


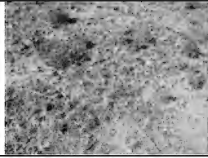
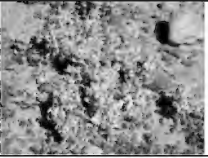



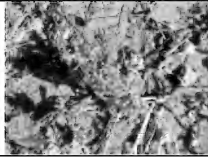




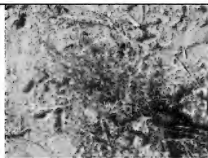

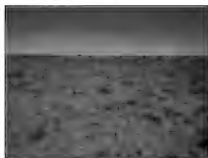
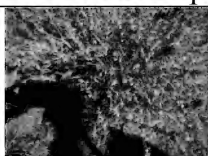
Transect B				
	Cinnamon Quail-thrush	Water erosion in sand plain	Gibber plain	Seedling saltbush on clay pan
Corner point 3	Right: 	Left: 		
	Habitat: Gibber plain			
Transect C				
	Cattle pads and tracks along creek-line	<i>Polycalymma stuartii</i> , Poached Egg Daisy	<i>Ptilotus nobilis</i> , Yellow-tails	<i>Senecio gregorii</i> , Fleshy Groundsel
				
	<i>Rhodanthe floribunda</i> , White Paper-daisy	<i>Acacia tetragonophylla</i> , Dead Finish	Cattle pads and tracks along creek-line	<i>Acacia cyperophylla</i> , Red Mulga
				
	<i>Malvastrum americanum</i>	<i>Abutilon leucopetalum</i> , Lantern Bush	<i>Cullen pallidum</i>	
Corner point 4	Right: 	Left: 		
	Habitat: Gibber plain dissected by creeks with Red Mulga			
Transect D				
	<i>Acacia tetragonophylla</i> , Dead Finish	Gibber plain with saltbush in drainage lines	<i>Goodenia fascicularis</i>	<i>Cenchrus ciliaris</i> , Buffel Grass





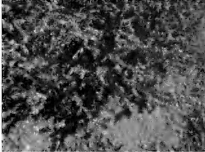
				
	<i>Senna artemisioides</i> ssp. <i>oligophylla</i> , Limestone Cassia	<i>Maireana</i> sp.		
Transect E				
	Gibber plain alongside creek with Red Mulga			
Corner point 5	Right: 	Left: 		
	Habitat: Stony rise alongside creek with Red Mulga			
Transect F				
	Stony mound	Fresh camel droppings		
Corner point 6	Right: 	Left: 		
	Habitat: Heavily wooded creek-line dominated by Red Mulga			
Transect G				
	<i>Eremophila maculata</i> , Spotted Fuchsia	<i>Senna artemisioides</i> ssp. <i>oligophylla</i> , Limestone Cassia	<i>Abutilon</i> sp.	<i>Cullen australasicum</i> , Tall Scurf-pea
				
	<i>Euphorbia tannensis</i> ssp. <i>eremophila</i> , Desert Spurge	<i>Leiocarpa leptolepis</i> , Pale Plover Daisy	Gibber plain with clay pan	Gibber plain

Corner point 7	Right: 	Left: 		
	Habitat: Undulating sandy/stony plain with low saltbush			
Transect H				
	Ephemeral water course	<i>Leiocarpa leptolepis</i> with salt bush and <i>Acacia</i>	Rocky creek-line with Red Mulga	

Census stop 8 Date: 29-07-2017 Commenced: 10:25
Weather: Warm, light breeze
Number of observers: 6
Habitat: Clay plain, open shrubs - Dead Finish, Senna etc

Corner point 1	Right: 	Left: 		
	Habitat: Sand plain with open shrubs, Dead Finish, <i>Senna</i> , etc. Heavily grazed			
Transect A				
	<i>Leiocarpa leptolepis</i> , Pale Plover Daisy	Heavily grazed saltbush	<i>Goodenia lunata</i>	Creek-bed with heavy use by cattle
				
	<i>Leiocarpa leptolepis</i> , Pale Plover Daisy	Clay plain with low saltbush and sparse grasses	<i>Streptoglossa adscendens</i>	Heavily used cattle track
				
	Mixed saltbush and other herbs	<i>Acacia sp.</i> and dense herb cover along creek-line	<i>Atalaya hemiglauca</i> , Whitewood	
Corner point 2	Right: 	Left: 		
	Habitat: Drainage line with scattered shrubs – <i>Hakea</i> , <i>Acacia</i> , Whitewood			
Transect B				
	Drainage line	<i>Swainsona campylantha</i>	Heavily used cattle track	Stony rise with low saltbush

				
	<i>Hibiscus brachysiphonius</i>	Stony plain with saltbush	<i>Atriplex spongiosa</i> , Pop Saltbush	
Corner point 3	Right: 	Left: 		
	Habitat: Gibber rise with low saltbush			
Transect C				
	Gibber plain with creek in distance	<i>Rhodanthe microglossa</i>	Clay pan with scattered boulders	
Corner point 4	Right: 	Left: 		
	Habitat: Clay pan, 50% cover of low saltbushes			
Transect D				
	Diversity of forbs	<i>Stemodia glabella</i>		
Transect E	No Photos			
Corner point 5	Right: 	Left: 		
	Habitat: Sand plain, open grassland with saltbush, sparse woodland			
Transect F				
	<i>Eremophila obovata</i>			

Corner point 6	Right: 	Left: 		
	Habitat: Sand plain with open Mulga woodland, grasses and saltbush			
Transect G	No photos			
Corner point 7	Right: 	Left: 		
	Habitat: Sand plain with open shrubs and sparse grasses			
Transect H				
	<i>Eremophila macdonnellii</i>			

APPENDIX IV – CLIMATE

The area surveyed falls within the arid zone of north-east South Australia.

1. Rainfall

The closest weather station to the survey area is Bureau of Meteorology station number 17028 at Innamincka Station. The rainfall record for this station goes back to 1882 with latest records being for 2016.

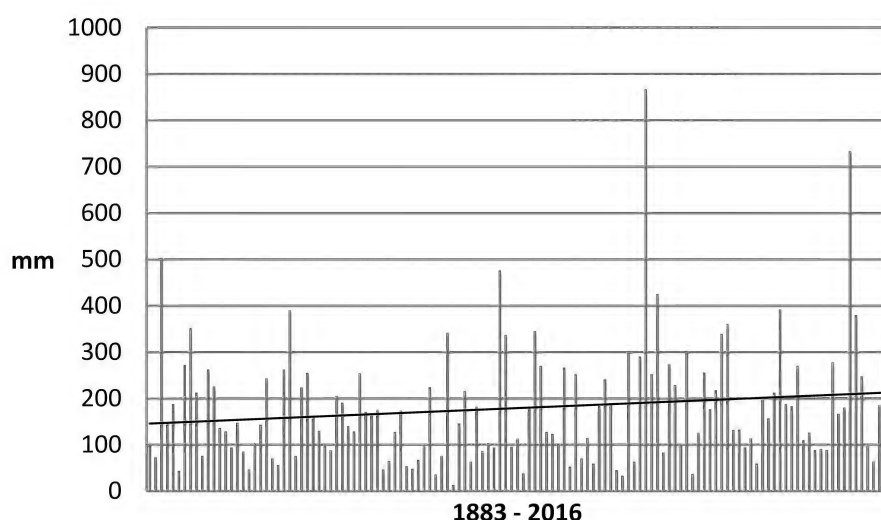


Fig. 2. Innamincka Station rainfall total per year and linear trend 1883-2016

Annual rainfall is extremely variable but shows a slight upward trend over the last 133 years. This trend is still evident after excluding the extreme rainfall years of 1974, 2010 and 2016.

Source: Bureau of Meteorology

The closest meteorology station to the survey area with rainfall records for 2017 is Durham Downs (station 45005), 97km to the east. This weather station recorded 79.6mm of rain for the year to December with the highest recording being 31.9mm in January. To the north, Mt Leonard Station at a distance of 133km recorded an annual total of 112.1mm with 44.0mm in January while Moomba Airport, 154km south, recorded an annual total of 97.6mm of which 32.6mm fell in January. All stations recorded falls of up to 12mm in March and of 0-3mm during April to July leading up to the survey.

2. Temperature

The closest weather station to the survey area that records temperature is Bureau of Meteorology station number 17123 at Moomba. The temperature records go back to 1996.

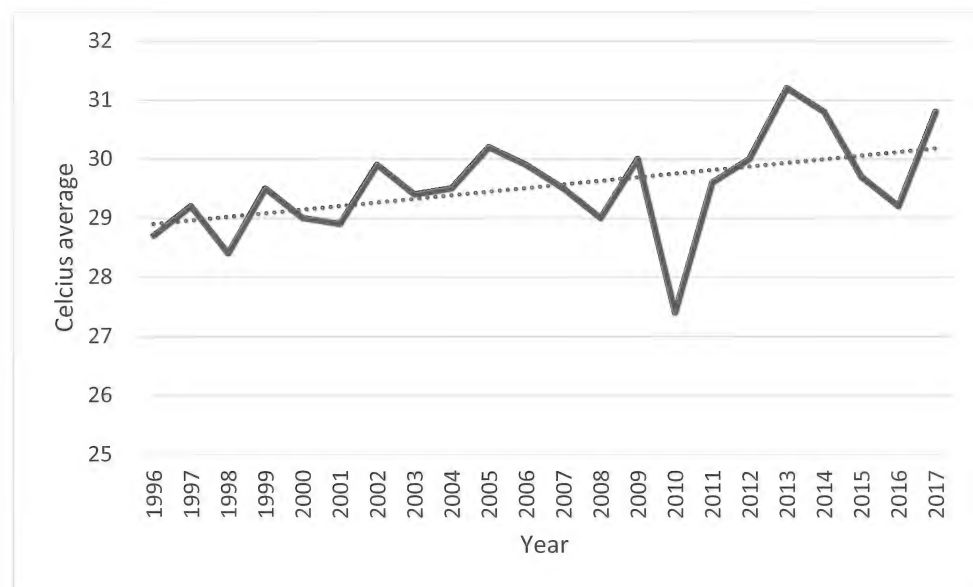


Fig. 3. Moomba Airport (17123) average annual temperature 1996-2017 with trend

Source: Bureau of Meteorology

There has been an upward trend in average annual temperature over the period records have been collected i.e. since 1996.

APPENDIX V – USING A GPS TO NAVIGATE TRANSECT SQUARES

Each survey team needs to have at least one member with a GPS unit and some basic skills in using it. Given that a variety of GPS units will be brought to the survey task by different volunteers, the following guidelines are generic in nature.

Two alternative methods are given below for navigating the two transect squares for each census stop.

Preliminary Skills

Users should come to the task knowing how to:

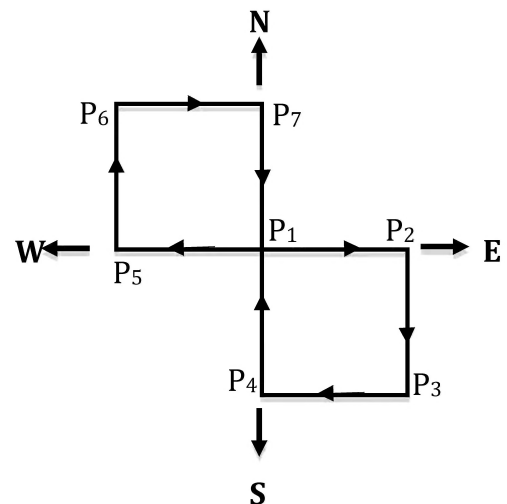
1. set up their GPS units to locate positions using
 - (a) metric units
 - (b) UTM position format[for the Innamincka area the UTM zone/band is 54 J and the position is given by a 6 or 7 digit **easting** (depending on whether or not the leading zero is shown) and and a 7 digit **northing**. E.g. 54 J 0467632 6929509. These numbers may appear on two lines, with the easting on the top line. The “54 J” may or may not be shown]
2. mark and find waypoints
3. show, not necessarily on the same page/screen
 - (a) the easting and northing for the current position
 - (b) the distance from a given waypoint

METHOD 1

Navigating Transect Squares

Starting at census stop SL1 corner point 1 (P₁ in the diagram), the survey consists of two transect squares with the 500 m sides oriented along the principal compass directions as shown.

1. Mark P₁ as a waypoint on the GPS unit (e.g. call it waypoint 101)
Record the easting and northing in a notebook (see Table below).
2. Select “Find” or “GoTo” waypoint 101 – your unit should tell you that you are already there!
3. Walk in an easterly direction by keeping the northing constant (you may need to adjust it by veering southwards to reduce the northing to the desired value, or by veering northwards to increase the northing to the desired value.) It is not necessary to be exactly due east of P₁ at all times so it is quite OK to make detours around obstacles such as thorn bushes!
4. While proceeding eastwards, check your distance from P₁ from time to time. When this distance approaches 500 m adjust your position so that your northing is exactly the same as at P₁ and your distance from P₁ is exactly 500 m. Mark this point as P₂ (e.g. waypoint 102) and record the easting and northing in your notebook.
5. Repeat the above process to locate P₃, 500 m south of P₂. This time you will need to keep the easting constant and the northing will decrease as you go.
6. Repeat the above process for each side of the two transect squares.



Notes

- Eastings get larger as you move eastwards and smaller as you move westwards. Northings get larger as you move northwards and smaller as you move southwards.
- A possible format for your record book is shown. Note that eastings and northings are alternatively equal as you move from one point to the next.

Census stop SL1 Waypoints

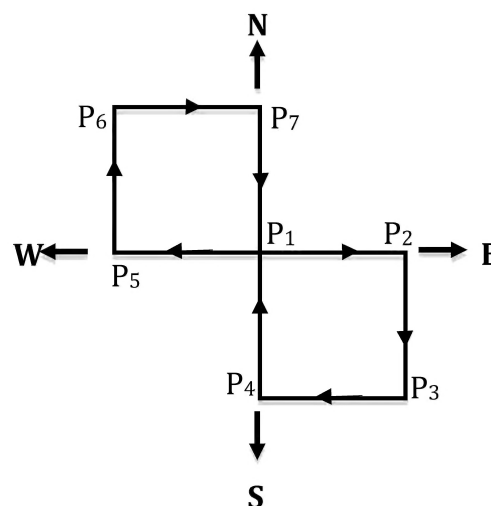
Waypoint	Easting	Northing
101 (P ₁)	a	b
102 (P ₂)	c	b
103 (P ₃)	c	d
104 (P ₄)	a	d
101 (P ₁)	a	b
105 (P ₅)	e	b
106 (P ₆)	e	f
107 (P ₇)	a	f
101 (P ₁)	a	b

METHOD 2

Navigating Transect Squares

Starting at census stop SL1 corner point 1 (P₁ in the diagram), the survey consists of two transect squares with the 500 m sides oriented along the principal compass directions as shown.

1. Mark P₁ as a waypoint on the GPS unit (e.g. call it waypoint 101). In a notebook draw up a table as shown below and record the easting ('*e*') and northing ('*n*') of P₁.
2. Calculate the eastings and the northings for the other seven corner points of the survey squares by adding or subtracting 500 as shown by the formulas in the table. Enter all eastings and northings on your table.



Census Stop SL1 Waypoints

Waypoint	Easting	Northing
101 (P ₁)	<i>e</i>	<i>n</i>
102 (P ₂)	<i>e</i> +500	<i>n</i>
103 (P ₃)	<i>e</i> +500	<i>n</i> -500
104 (P ₄)	<i>e</i>	<i>n</i> -500
101 (P ₁)	<i>e</i>	<i>n</i>
105 (P ₅)	<i>e</i> -500	<i>n</i>
106 (P ₆)	<i>e</i> -500	<i>n</i> +500
107 (P ₇)	<i>e</i>	<i>n</i> +500
101 (P ₁)	<i>e</i>	<i>n</i>

3. Walk in an easterly direction by keeping the northing constant (you may need to adjust it by veering southwards to reduce the northing to the desired value, or by veering northwards to increase the northing to the desired value). It is not necessary to be exactly due east of P_1 at all times so it is quite OK to make detours around obstacles such as thorn bushes!
4. While proceeding eastwards, monitor the easting of your current position. When this approaches the desired easting ($e+500$) adjust your position so that your northing is exactly the same as at P_1 (n) and your easting is exactly ($e+500$). You have now reached the point P_2 (waypoint 102).
5. Repeat the above process to locate P_3 , 500m south of P_2 . This time you will need to keep the easting constant and the northing will decrease as you go.
6. Repeat the above process for each side of the two transect squares.

Note

- Eastings get larger as you move eastwards and smaller as you move westwards. Northings get larger as you move northwards and smaller as you move southwards.
- Example calculation:

Census Stop SL1 Waypoints

Waypoint	Easting		Northing	
101 (P_1)	e	0431028	n	6953816
102 (P_2)	$e+500$	0431528	n	6953816
103 (P_3)	$e+500$	0431528	$n-500$	6953316
104 (P_4)	e	0431028	$n-500$	6953316
101 (P_1)	e	0431028	n	6953816
105 (P_5)	$e-500$	0430528	n	6953816
106 (P_6)	$e-500$	0430528	$n+500$	6954316
107 (P_7)	e	0431028	$n+500$	6954316
101 (P_1)	e	0431028	n	6953816

While it would be possible to manually input these co-ordinates into the GPS unit and to then use the “Find” or “GoTo” function, the process would be time-consuming and tedious and the following of the direction arrow is not likely to give a more precise transect square than the method of maintaining eastings and northings detailed above.

APPENDIX VI - EQUIPMENT LIST

- EPIRB (if you have one) or Satellite phone (if you have one)
- Hand-held UHF radio for staying in contact while surveying (*to be carried on your person at all times when out of the car, along with at least one set of spare batteries*)
- GPS for each group (*to be carried at all times when out of the car, along with at least one set of spare batteries*)
- Compass (*to be carried on your person at all times when out of the car*)
- Plenty of spare batteries
- Survey sheets and a clip board, notebook and pencils
- Watch for telling the time (or use GPS clock)
- Digital camera with large memory card
- Small ruler or measuring card for photographing with tracks etc.
- Car chargers for the various pieces of electronic equipment / rechargeable batteries
- Car chargers for the various pieces of electronic equipment / rechargeable batteries
- Star picket / dropper, plastic dropper cap, star dropper plunger
- Census point marker plate stamped for census point e.g. FOIR SL01, bolt, washer and nut, spanner
- Personal protective equipment (PPE)
- First Aid box